Speech Perceptual Learning Across Distorted Input in Developmental Dyslexia

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INTRODUCTION

- Developmental Dyslexia (DD) has been mainly attributed to phonological deficits.
- However, an accumulating body of evidence implicates procedural learning impairments in DD (Nicolson & Fawcett, 2011; Ullman, 2004).
- Although procedural learning impairments are believed to have an especially deleterious impact on the acquisition of language, research with individuals with DD has mostly focused on procedural learning in the motor domain.
- Likewise, there is a growing appreciation for the central role of online perceptual learning as an important aspect of speech perception among typical listeners (Guediche et al., 2014).
- Although the basis of this learning is a topic of debate, there is reason to posit involvement of procedural learning (Fahle, 2005).
- Perceptual learning in online speech perception is mostly uncharted in dyslexia research.

RESEARCH AIM

- Here, we examine perceptual learning of speech and its generalization in individuals with dyslexia and typical readers.

METHOD

Participants: 12/17 dyslexics and 12/17 neurotypicals completed time-compressed /spectrally shifted speech tasks, respectively including psychometric tests.

The DD and Control groups did not differ in intelligence or chronological age. However, there were significant group differences with regard to reading, naming and phonological skills.

Time-compressed speech stimuli:
Sentences that were time-compressed using a WSOLA algorithm (Verhelst & Roelands, 1993) which changes speech rate but preserves other qualities such as pitch and timbre.

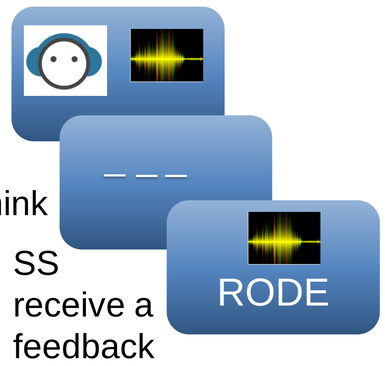
Spectrally shifted speech stimuli:
Phonetically-balanced words (Egan, 1948) were vocoded and spectrally shifted in a manner that compressed spectral information and shifted upward in frequency.

Training
Incremental distortion

SS hear a distorted stimulus

SS indicate what they think they heard

SS receive a feedback

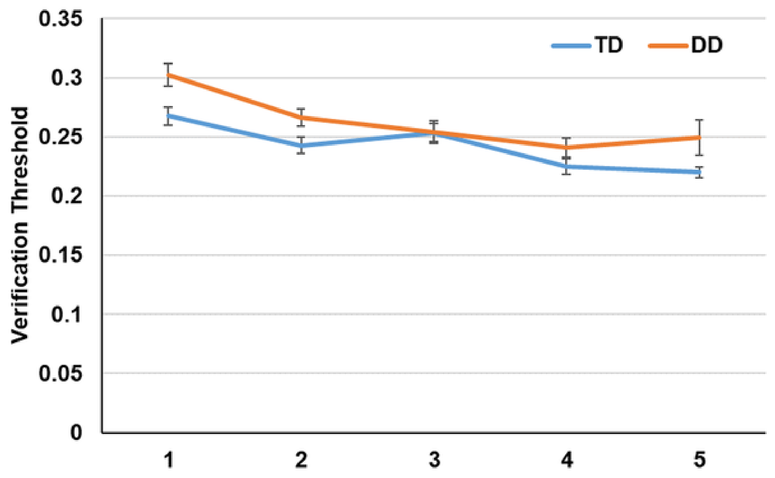


Pre vs. Posttest
Severe distortion

Time-Compressed Speech Task -Results

TRAINING

The interaction of group by learning was not significant (F<1)

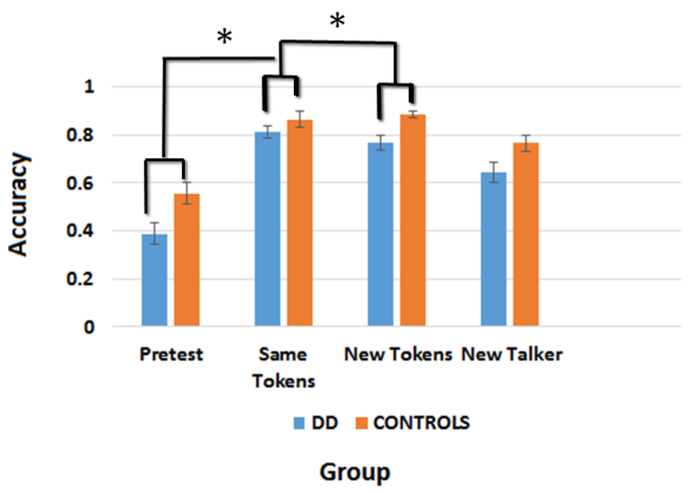


PRE VS. POST TEST

Same talker - A significant pre/post by group interaction (F (1, 22) = 6.63, p<.05)

New tokens - A significant group-by-token type interaction, (F (1, 22) = 6.88, p<.05)

New talker – The group-by-token type interaction was not significant, (F (1, 22) = 2.85, p = .10)

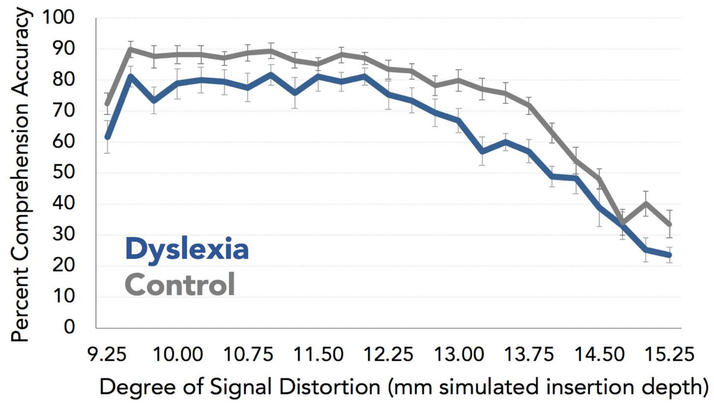


Spectrally Shifted Speech Task -Results

TRAINING

A significant main effect of group, (F (1, 32)=15.74, p<.01)

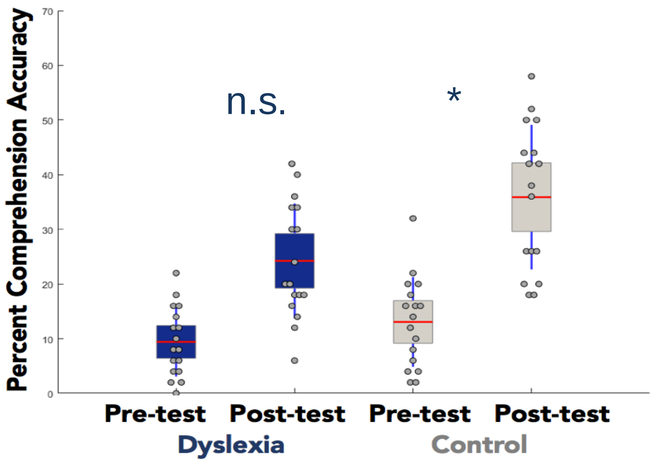
The interaction of group by distortion level was not significant (F<1)



PRE VS. POST TEST

A significant main effects of group (F (1, 32)=6.94, p<.05) and test, (F (1, 32)=113.09, p<.01)

A significant pre/post by group interaction, (F (1, 32) = 5.1, p<.05)



CONCLUSIONS

- Although we used different linguistic units, different types of distortion and different approaches to feedback, the converging evidence from both studies suggest that listeners with DD were less able to transfer learning-related gains to tokens they had not encountered under distortion. They were less efficient at generalization.
- Individuals with dyslexia may exhibit less efficient perceptual learning across existing phonological representations in the context of online listening.
- Less efficient perceptual learning across speech distortions may impact the ability of individuals with dyslexia to deal with variability arising from sources like acoustic noise and foreign-accented speech.

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